BRIEF COMMUNICATIONS

Maintenance of Optimal Fluoride Levels in Public Water Systems

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Abstract

Objective: *This study examines the quality of water fluoridation in public water supplies.* ***Methods:*** *An assessment of daily fluoride levels among all communities that fluoridate their public water supplies in New Hampshire was conducted from January 1, 2000, through June 30, 2002. Results were compared against recommendations from the Centers for Disease Control and Prevention.* ***Results:*** *The fluoride concentration was less than the recommended minimum value on 42.0 percent of days, within the accepted control range on 49.8 percent of days, and above the recommended maximum value on 1.0 percent of days. On 7.1 percent of days, a fluoride concentration was not determined. Only 2 (18.2%) of 11 public water supplies maintained the fluoride concentration in the optimal range* ≥80 percent of the days. ***Conclusions:*** *For public water supplies in New Hampshire that fluoridate, suboptimal levels are the most common problem. Water systems need to better maintain recommended fluoride levels if communities are to realize the full benefits of fluoridation. [J Public Health Dent 2004;64(3):237-39]*

Key Words: fluoridation, water, oral health, optimal levels, quality control.

The fluoridation of community water supplies is considered one of 10 great public health accomplishments of the 20th century (1). At the recommended optimal levels, fluoride is effective in preventing tooth decay (2). However, below the recommended levels there is less benefit in preventing caries and above the recommended levels, fluorosis can occur (2). This report presents the results of an assessment of how well optimal fluoride levels are maintained among the communities in New Hampshire that adjust the fluoride concentration of their public water supplies.

Methods

Data on daily fluoride concentrations during January 1, 2000–June 30, 2002, were obtained from the New Hampshire Department of Environmental Services. Communities that fluoridate their public water supply submit these results to the department on a monthly basis. Fluoride concentrations were determined either directly by laboratory analysis or indirectly by dividing the amount of fluoride used by the volume of water produced daily. Optimal fluoride levels and control ranges (i.e., minimum and maximum acceptable levels) for each community were based on the 30-year (1971–2000) annual average maximum daily air temperatures for each community and Centers for Disease Control and Prevention (CDC) recommendations (3). Optimal fluoride levels vary with air temperature based on studies showing that persons living in warmer climates drink more water than persons in cooler climates. For two communities temperature data were unavailable, so data from a neighboring town were used. Data were entered and analyzed using Epi Info 2002 (CDC, Atlanta, GA).

Ten communities in New Hampshire fluoridate their public water supply. One community has two water systems, both fluoridated, that serve the town and a local university. The median population of these 10 com-

FIGURE 1
Daily Fluoride Concentration, Community E, January 2001 (Control Range=1.0–1.6 ppm)

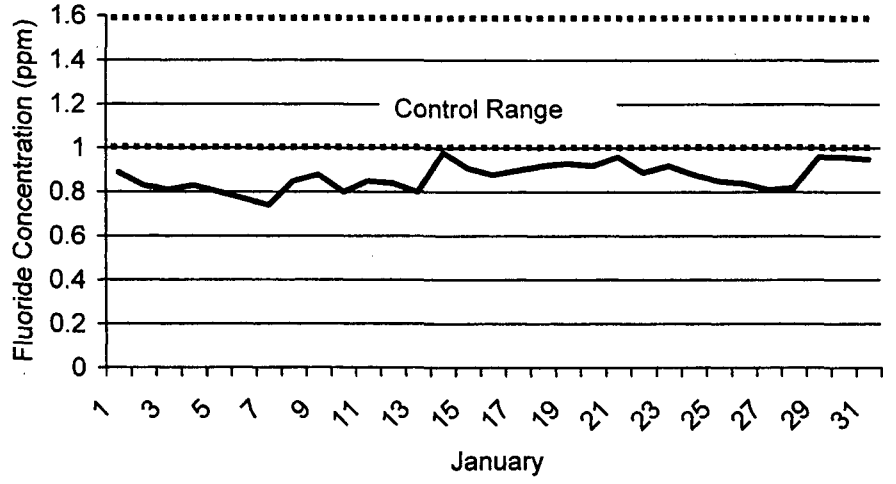

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TABLE 1
Annual Average Maximum Daily Temperatures, Recommended Fluoride Concentration, Days without Determining Fluoride Concentration, and Days with Fluoride Concentration Below, In, or Above Control Range, by Community—New Hampshire, January 1, 2000–June 30, 2002

Community	30 yr* Annual Ave. Max. Daily Temps (°F)	Recommend. Fluoride Concentration in ppm (Control Range)	Days without Fluoride Determination (%)	Days with Fluoride Concentration (%)		
				Below Control Range	In Control Range	Above Control Range
A	57.7	1.1 (1.0–1.6)	0 (0)	317 (34.8)	595 (65.2)	0 (0)
B	58.9¶	1.0 (0.9–1.5)	24 (2.6)	49 (5.4)	839 (92.0)	0 (0)
C (town)†	58.9	1.0 (0.9–1.5)	5 (0.6)	443 (49.8)	431 (48.5)	10 (1.1)
C (univ.)†	58.9	1.0 (0.9–1.5)	0 (0.0)	186 (23.6)	588 (74.7)	13 (1.7)
D	57.1	1.1 (1.0–1.6)	234 (25.7)	535 (58.7)	141 (15.5)	2 (0.2)
E	56.3	1.1 (1.0–1.6)	0 (0)	884 (96.9)	28 (3.1)	0 (0)
F	52.6	1.2 (1.1–1.7)	359 (39.4)	147 (16.1)	375 (41.1)	31 (3.4)
G	55.8	1.1 (1.0–1.6)	1 (0.1)	556 (61.0)	354 (38.8)	1 (0.1)
H‡	58.0	1.1 (1.0–1.6)	0 (0)	412 (73.7)	147 (26.3)	0 (0)
I	58.6	1.0 (0.9–1.5)	56 (6.1)	403 (44.2)	412 (45.2)	41 (4.5)
J	58.9¶	1.0 (0.9–1.5)	0 (0)	69 (7.6)	842 (92.3)	1 (0.1)
Total	—	—	679 (7.1)	4,001 (42.0)	4,752 (49.8)	99 (1.0)

*1971–2000.
†Analysis restricted to days in which utility pumped water.
‡Fluoridation started on December 19, 2000.
¶Based on temperature data from a neighboring community.

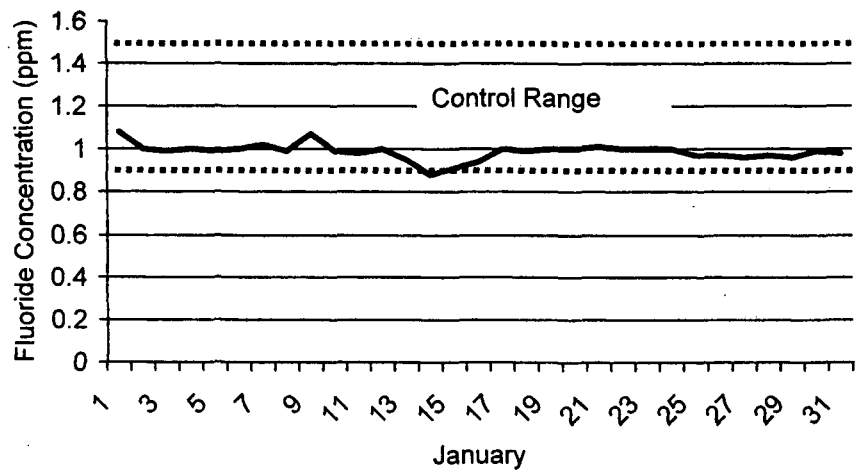
munities was 14,800 (range: 2,160–128,000). These communities account for approximately 39 percent of the state population served by a public water system.

Results

The percentage of days in the study period during which a community's concentration of fluoride was not determined ranged from 0 to 39.4 percent (mean=7.1%) (Table 1). The percentage of days during which a community's fluoride concentrations was known to be in the control range varied from 3.1 percent to 92.3 percent (mean=49.8%). Fluoride concentrations were more often below the control range (42.0% of days) than above the control range (1.0% of days). Only 2 (18.2%) of the 11 public water supplies maintained the fluoride concentration in the optimal range ≥80 percent of the days.

Several different patterns in fluoride concentrations were noted among the 10 communities. In Community E, fluoride concentrations varied over a small range (0.7–1.0 ppm), but were consistently below the control range of 1.0–1.6 ppm (Figure 1). In Community J, concentrations again varied over a relatively small range (0.9–1.1 ppm), but were almost always within the control range of 0.9–1.5 ppm (Figure 2). In Community C (town), fluoride concentrations varied substantially (0.3–1.6 ppm) and fell within the control range of 0.9–1.5 ppm approximately two-thirds of the time (Figure 3).

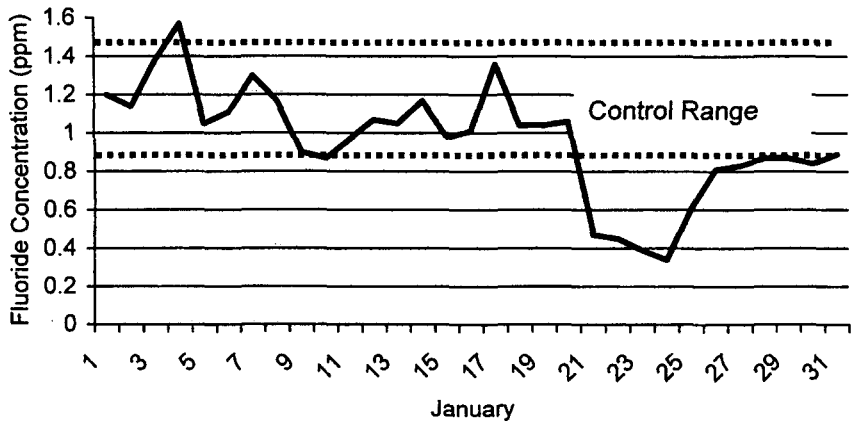
FIGURE 2
Daily Fluoride Concentration, Community J, January 2001 (Control Range=0.9–1.5 ppm)



Discussion

Although fluoridation of drinking water is recognized as an effective method of preventing dental caries, fluoride concentrations can vary markedly among communities that fluoridate (4,5). Fluoride concentrations below the recommended minimum level are the most common problem (4,5). Factors associated with

FIGURE 3
Daily Fluoride Concentration, Community C (Town), January 2001
(Control Range=0.9–1.5 ppm)



maintenance of optimal fluoride levels include operator training, operator turnover, source of water, and population size (6,7). Efforts to optimize fluoride levels have included a variety of approaches, including legal requirements, computerized databases that track fluoride levels, and compliance indices (8). CDC has made recommendations to state fluoridation programs concerning engineering and administrative practices (3) and has developed the Water Fluoridation Reporting System to help states and tribal governments monitor fluoride levels (9).

Although effective water fluoridation can prevent dental decay, caries remains a common problem in New Hampshire. In 2001, a total of 52 percent of students in third grade in public schools had a history of dental caries (10). Compared with other states, in 2000 New Hampshire had the eighth lowest percentage of its population receiving optimally fluoridated water through public water systems (9). One of New Hampshire's health objectives for 2010 is to increase this proportion from 43 percent to 65 percent. In New Hampshire, the level of fluoridation is both decided and managed at the local level; no state statutes or regulations address the maintenance of optimal fluoride levels.

The findings in this report are subject to at least two limitations. First, water plant operators might not have known about the fluoride recommendations made by CDC. Results of a survey in 2001 indicated that many operators established optimal values and control ranges for their communities below the recommended values (New Hampshire Department of Health and Human Services, unpublished data, 2001). Second, methods to determine fluoride concentrations were not standardized among communities, and the state did not request communities to report which method they used. Indirect methods for calculating fluoride concentrations might be unreliable. None of the communities that adjust fluoride levels in New Hampshire regularly submitted split samples for testing to an outside laboratory to verify their results.

To improve water fluoridation, communities that adjust their fluoride concentrations should determine the fluoride concentration of their water on a daily basis using a laboratory-based method, submit split specimens for fluoride testing to a certified laboratory on a monthly basis, and comply with the optimal fluoride levels and control ranges recommended by CDC (3). Based on the results of this study, the New Hampshire Department of Health and Human Services and Department of Environmental Services plan to provide annual training on fluoridation to water plant operators, monitor fluoride levels through the Water Fluoridation Reporting System (9), and encourage communities to adopt CDC recommendations for fluoridation programs (3).

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